

p o s t – L A B

elements and compounds of the third period (Na across to Ar)

- Pre-labs help you understand and get more from your lab work experience.
- Pre-labs must be completed in your lab notebook before arriving in class to take the lab.

1. **Metals and non-metals behave differently.** Comment on how this shows itself in parts 3, 5, 6, 7 and 8.

“THE TREND ACROSS THE PERIOD” – when we “state” a trend we just write the patterns we see; we do not try to explain them. When we “comment” we make a judgment based on a result (e.g. from an experiment or calculation).

- 3). Electrical conductivity:
 - Na, Mg, Al are all good conductors of electricity
 - Si is a poor conductor of electricity
 - P, S, Cl, (Ar) are non-conductors of electricity

THE TREND ACROSS THE PERIOD: Elemental metals are good electrical conductors. Elemental non-metals do not conduct electrical at all. As metals transition into non-metals, Si exhibits some (poor) electrical conductivity.

- 5). The action of acids: hydrochloric acid
 - $2\text{HCl}_{(\text{aq})} + \text{Mg}_{(\text{s})} \rightarrow \text{H}_{2(\text{aq})} + \text{MgCl}_{2(\text{aq})}$ pop test confirms $\text{H}_{2(\text{g})}$
 - $6\text{HCl}_{(\text{aq})} + 2\text{Al}_{(\text{s})} \rightarrow 3\text{H}_{2(\text{aq})} + 2\text{AlCl}_{3(\text{aq})}$ (needs to be warmed a little)
 - $\text{HCl}_{(\text{aq})} + \text{Si}_{(\text{s})} \rightarrow \text{none}$
 - $\text{HCl}_{(\text{aq})} + \text{S}_{(\text{s})} \rightarrow \text{none}$

THE TREND ACROSS THE PERIOD: Metals react with HCl to produce hydrogen gas and non-metals do not. Al is positioned where metals transition into non-metals and needs a little help (heat) to react but it will react.

- 6). The action of alkalis: sodium hydroxide (you do not need to memorise these rxns)
 - $\text{NaOH}_{(\text{aq})} + \text{Mg}_{(\text{s})} \rightarrow \text{none}$
 - $2\text{Al}_{(\text{s})} + 2\text{NaOH}_{(\text{aq})} + 6\text{H}_2\text{O} \rightarrow 2\text{Na}^+_{(\text{aq})} + 2[\text{Al}(\text{OH})_4]^- + 3\text{H}_{2(\text{g})}$ - amphoteric
 - $\text{Si}_{(\text{s})} + 4\text{NaOH}_{(\text{aq})} \rightarrow [\text{SiO}_4]^{4-}_{(\text{aq})} + 4\text{Na}^+_{(\text{aq})} + 2\text{H}_{2(\text{g})}$
 - $\text{S}_{8(\text{s})} + 6\text{KOH}_{(\text{aq})} \rightarrow 2\text{K}_2\text{S}_3 + \text{K}_2\text{S}_2\text{O}_3 + 3\text{H}_2\text{O}_{(\text{l})}$

THE TREND ACROSS THE PERIOD: Metals do not react with alkalis. Non-metals will react with alkalis but will sometimes need some heat. At the transition where metals become non-metals both Al and Si produce hydrogen gas. Aluminium, although metal, is amphoteric, and will react with BOTH acids and bases (alkalis).

- 7). The chlorides

NaCl	white crystalline solid	dissolves in H_2O	pH neutral
MgCl ₂	white crystalline solid	dissolves in H_2O	pH neutral
AlCl ₃	white crystalline solid	reacts with $\text{H}_2\text{O} \rightarrow \text{HCl}$	pH acidic
PCl ₃	colourless liquid	reacts with $\text{H}_2\text{O} \rightarrow \text{HCl}$	pH acidic

THE TREND ACROSS THE PERIOD: metals are all white crystalline solids. Non-metals are likely to be colourless liquids if the phosphorus is a typical example. Metals tend to dissolve in water while non-metals react to produce acidic solutions. Aluminium appears as metals transition into non-metals and is showing more non-metal behaviour in its reaction with water rather than dissolving in water like the other metals.

- 8). The oxides
 - Na_2O reacts with $\text{H}_2\text{O} \rightarrow \text{NaOH}$ alkaline solution pH basic
 - MgO reacts with $\text{H}_2\text{O} \rightarrow \text{Mg}(\text{OH})_2$ (weak) alkaline solution pH basic
 - Al_2O_3 no rxn
 - SiO_2 no rxn
 - P_4O_{10} reacts with $\text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_4$ acidic solution pH acidic
 - SO_3 reacts with $\text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$ (strong) acidic solution pH acidic

THE TREND ACROSS THE PERIOD: metallic oxides in water produce alkaline solutions (they have OH^- ions). Non-metallic oxides in water produce acidic solutions (they have H^+ ions). The elemental oxides that lie on opposite sides of the transition line from metals to non-metals (Al and Si) do not react or dissolve in water.

2. Comment on the unexpected behaviour of Al and Si.

Throughout this experiment we could see (“it was evident”) that the chemical behaviour of both the elemental Al and Si and the oxides and chlorides (compounds) of Al and Si (show) can be both metallic and non-metallic. Example: in #6, silicon reacts with NaOH to produce hydrogen gas like the metal Al does. In #7 aluminium chloride, metallic chloride reacts with water to produce an acidic solution like phosphorus trichloride (PCl_3) the non-metallic chloride does.

An **alkali** is a soluble **base** that produces OH^- ions in solution. Just in case you ever wanted to know why we use these two words at different times when they seem to mean the same thing. Example: NaOH is a base that dissolves in water so it is an alkali. $\text{Fe}(\text{OH})_2$ is a base but does not dissolve in water so it is not an alkali.

